WATER RESOURCES REVIEW for

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

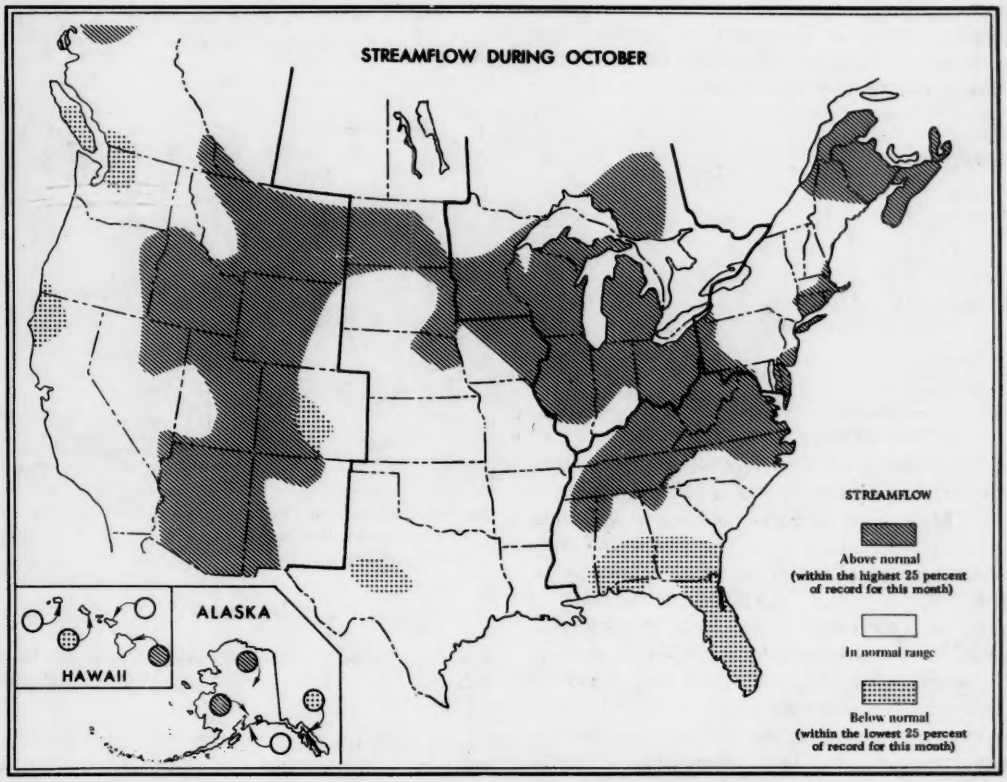
CANADA
DEPARTMENT OF THE ENVIRONMENT
WATER RESOURCES BRANCH

OCTOBER
1972

STREAMFLOW AND GROUND–WATER CONDITIONS

Streamflow increased seasonally in most of the United States and southeastern Canada; but decreased in parts of Alaska, as well as in the northern part of the West, the central part of the Midcontinent, and in Alabama, Florida, and southern Georgia. Moderate to severe flooding occurred in many areas, including Baranof and Chichagof Islands in southeastern Alaska; parts of Arizona, California, Colorado, and New Mexico in the West; parts of Texas, Oklahoma, Arkansas, and Louisiana in the Midcontinent; and also in southern Virginia.

Large areas of above-normal streamflow persisted in southern Canada and the northern half of the United States, and expanded southward through the central part of the West, and into the northern part of the Southeast region. Above-normal flows occurred also in south-central Alaska. Below-normal flows continued in northwestern California, northwestern and central Florida, and in southern Alabama and Georgia.

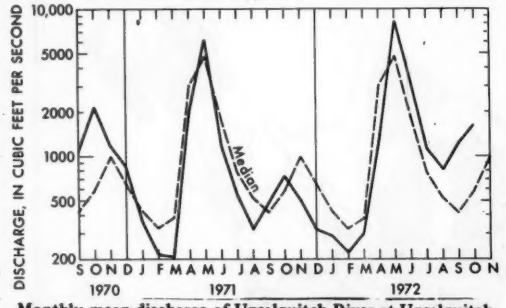


NORTHEAST

[Atlantic Provinces and Quebec; Delaware, Maryland, New York, New Jersey, Pennsylvania, and the New England States]

STREAMFLOW INCREASED GENERALLY THROUGHOUT THE ENTIRE REGION, BUT DECREASED IN PARTS OF NEW YORK, NEW JERSEY, AND MARYLAND. FLOWS WERE ABOVE NORMAL IN A LARGE AREA IN THE NORTH, INCLUDING NEW BRUNSWICK, NOVA SCOTIA, AND NORTHERN MAINE, AND IN SMALL AREAS IN THE SOUTH.

In northern Maine, monthly mean flow of St. John River below Fish River at Fort Kent increased seasonally, to almost twice the October median, and remained in the above-normal range for the 3d consecutive month. In nearby New Brunswick and Nova Scotia, flows at all index stations also increased seasonally, to monthly mean discharges ranging from 183 percent to 267 percent of the October medians. The monthly mean flow of Upsalquitch River at Upsalquitch, in northern New Brunswick, was above the normal range for the 2d consecutive month (see graph), and flow of La Have River at



Monthly mean discharge of Upsalquitch River at Upsalquitch, New Brunswick (Drainage area, 877 square miles.)

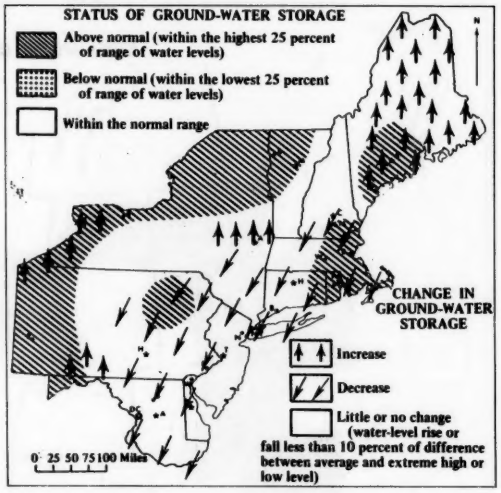
West Northfield, in southern Nova Scotia (drainage area, 484 square miles) increased from a September mean of 65.8 cfs (40 percent of median and below the normal range) to 1,020 cfs (239 percent of median and above the normal range) in October. In northern Nova Scotia, including Cape Breton Island, marked increases in monthly mean flows also occurred on St. Mary's River at Stillwater and Northeast Margaree River at Margaree Valley where October means were 267 percent and 224 percent of their respective medians.

In southern New Jersey, monthly mean flow of Great Egg Harbor River at Folsom (drainage area, 56.3 square miles) increased to 76.6 cfs as a result of above-normal rainfall throughout the month, and was in the above-normal range again where it has been during 10 of the past 14 months.

In Maryland, monthly mean flow of Seneca Creek at Dawsonville, which has been in the above-normal range for 14 consecutive months, decreased seasonally and was in the normal range for October.

At Washington, D.C., the monthly mean discharge of Potomac River increased sharply, from 3,260 cfs in September, to 11,100 cfs in October, almost 4 times the median for the month, and far above the normal range for October.

Ground-water levels continued to rise in Maine, and rose also in parts of New Jersey, New York, and Pennsylvania (see map). Levels declined in Connecticut, Rhode Island, and southeastern and central Massachusetts, as well as in Delaware, northern New Jersey, southeastern New York, eastern Maryland, and eastern Pennsylvania. Levels near monthend were in or above the normal range, including above-normal levels in northern and western New York and in western and northeastern Pennsylvania.



Map above shows ground-water storage near end of October and change in ground-water storage from end of September to end of October.

SOUTHEAST

[Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, Tennessee, Virginia, and West Virginia]

STREAMFLOW INCREASED IN THE REGION WITH THE EXCEPTIONS OF ALABAMA, FLORIDA, AND SOUTHERN GEORGIA. RECORD LOW FLOWS CONTINUED TO OCCUR IN FLORIDA AND SOUTHERN ALABAMA. RUNOFF INCREASED GREATLY AND WAS IN THE ABOVE-NORMAL

RANGE IN VIRGINIA, WEST VIRGINIA, KENTUCKY, TENNESSEE, AND IN NORTHERN NORTH CAROLINA, GEORGIA, AND MISSISSIPPI. MAJOR FLOODING OCCURRED IN SOUTHERN VIRGINIA.

Flows have been in the above-normal range throughout most of Virginia since May except for September when flows were normal. Heavy rains near the beginning of the month caused major flooding in the southern part of the State. Peak stages on some streams were the highest since 1940 (see table). Nottoway River near Stony Creek (station no. 2–0455 in the table) recorded the highest October monthly and daily flows in 44 years of record, 2,329 cfs and 15,600 cfs (on the 8th), respectively. In central Virginia, Slate River near Arvonia (drainage area, 226 square miles) with 47 years of record, also recorded a new October monthly maximum discharge of 652 cfs, almost nine times the October median, and a new daily maximum of 6,750 cfs, on the 6th.

In Tennessee, rainfall was nearly double the October normal over the entire State. In the Tennessee River basin, new maximum mean daily and monthly discharges for October occurred at stations on Emory River and Duck River, each with 45 years of record. The monthly mean discharge for Emory River at Oakdale (drainage area, 764 square miles) was 1,402 cfs, 25 times the median flow for the month, and the daily discharge of 12,600 cfs (on the 19th) was about twice the previously recorded maximum daily for October. Duck River above Hurricane Mills had a daily discharge of 34,100 cfs on the 21st, about 10,000 cfs greater than the previous

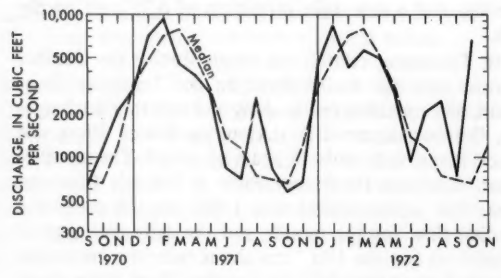
Provisional data; subject to revision

STAGES AND DISCHARGES FOR THE FLOODS OF OCTOBER AT SELECTED SITES IN VIRGINIA

WRD station number	Stream and place of determination	Drainage area (square miles)	Period of known floods	Maximum flood previously known			Maximum during present flood				
				Date	Stage (feet)	Discharge (cfs)	Date	Stage (feet)	Discharge		Recurrence interval (years)
									Cfs	Cfs per square mile	
POTOMAC RIVER BASIN											
1–6205	North River near Stokesville, Va.	17.2	1942 1946–	Oct. 1942 6/17/49	8.4 10.9	a 11,100	Oct. 5	6.58	3,660	213	*1.7
RAPPAHANNOCK RIVER BASIN											
1–6655	Rapidan River near Ruckersville, Va.	114	1942–	10/15/42	20.8	30,700	5	19.47	26,000	228	*1.3
1–6675	Rapidan River near Culpeper, Va.	472	1930–	10/16/42	30.3	58,100	6	26.28	42,600	90	50
JAMES RIVER BASIN											
2–0400	Appomattox River at Mattoax, Va.	726	1926–	8/18/40	35.3	35,000	7	31.2	22,700	31	50
2–0410	Deep Creek near Mannboro, Va.	158	1940 1946–	Aug. 1940 10/24/71	14.8 19.35	10,000 a	6	24.06	a	-----	-----
2–0416	Appomattox River at Matoaca, Va.	1,344	1969–	6/26/72	14.6	22,800	7	18.39	41,000	30	-----
CHOWAN RIVER BASIN											
2–0455	Nottoway River near Stony Creek, Va.	579	1929–	8/17/40	23.66	25,200	7	21.69	19,500	34	50
2–0460	Stony Creek near Dinwiddie, Va.	112	1940 1946–	Aug. 1940 9/ 1/64	----- 13.24	b8,000 4,530	7	20.84	a	-----	-----
2–0520	Meherrin River at Emporia, Va.	747	1940 1951–	8/17/40 1/ 9/62	30.0 23.17	40,000 12,900	7	27.35	24,000	32	*1.1
2–0525	Fontaine Creek near Brink, Va.	65.2	1940 1953–	Aug. 1940 5/ 7/58	18.5 18.18	2,720 2,660	6	24.14	a	-----	-----

*Ratio of discharge to that of 50-year flood.
[a]Not determined.

October daily maximum in 1945. Runoff for the month was 10 times the median (see graph).



Monthly mean discharge of Duck River above Hurricane Mills, Tenn. (Drainage area, 2,557 square miles.)

In contrast to Virginia and Tennessee, new low-flow records were established on Peace River, in south-central Florida, Shoal River, in the State's western panhandle, and Conecuh River, in adjacent southern Alabama. Shoal River near Crestview (drainage area, 474 square miles) decreased for the 5th consecutive month and produced an alltime low daily and monthly mean discharge, in the 35 years of record, of 292 cfs and 228 cfs (on the 17th), respectively. On Peace River at Arcadia (drainage area, 1,370 square miles), a minimum daily discharge of 58 cfs occurred on the 21st, less than half the previous minimum daily for October in 42 years of record. Conecuh River at Brantley (drainage area, 492 square miles) had an alltime low daily discharge in 36 years of record of 22 cfs on the 17th, 18th, and 24th.

In north-central Florida the flow of Silver Springs decreased to 735 cfs, 83 percent of normal. In the southeast, flow southward through the Tamiami Canal outlets, 40-mile bend to Monroe, decreased to 88 cfs, 15 percent of normal.

Ground-water levels rose in West Virginia, excluding the northwest part, and in parts of southeastern Florida (northern Dade and southern Broward Counties); but declined in central and western Kentucky, the Piedmont area of Georgia, North Carolina, Alabama, Mississippi, and northern and central Florida. Monthend levels were generally above average in northwestern West Virginia, Kentucky, and North Carolina; but were about average in Alabama and southeastern West Virginia; and were below average in Florida and the Piedmont and coastal areas of Georgia. Record lows were measured in observation wells in the Tuscaloosa, Graham Ferry, and Pascagoula Formations in Mississippi and in the "500-foot" sand at Memphis, Tenn. In general, water levels in shallow aquifers in the Southeast reflected the above-normal precipitation in the northern and western parts of the region and the below-normal precipitation in the southeastern part of the region.

WESTERN GREAT LAKES REGION

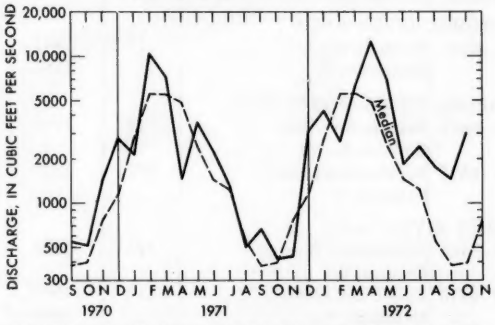
[Ontario; Illinois, Indiana, Michigan, Minnesota, Ohio, and Wisconsin]

STREAMFLOW INCREASED GENERALLY THROUGHOUT THE REGION AND REMAINED ABOVE THE NORMAL RANGE FOR THE SECOND CONSECUTIVE MONTH AT MOST OF THE INDEX STATIONS.

In Illinois, flows decreased slightly in the north but increased in the central area where monthly mean discharge of Sangamon River at Monticello (drainage area, 550 square miles) was 473 cfs, 15 times the October median. High carryover flow from September, and general rains October 21–22, resulted in above-normal October runoff in both areas.

In Michigan, streamflow increased at all index stations, as a result of killing frosts and general rains during the last half of the month, and was in the above-normal range throughout the State.

In Ohio, flows at all index streamflow stations continued above the normal range. The monthly mean discharge of Scioto River at Chillicothe increased seasonally, was 7½ times the October median, and remained in the above-normal range for the fourth consecutive month (see graph).



Monthly mean discharge of Scioto River at Chillicothe, Ohio (Drainage area, 3,849 square miles.)

In Wisconsin, streamflow generally has been in the above-normal range throughout the State for the past three months.

In east-central Minnesota, the monthly mean discharge of 614 cfs on Crow River at Rockford (drainage area, 2,520 square miles) was 9½ times the median for October and above the normal range for the 25th consecutive month.

Ground-water levels showed slight rises in most of the northern and western parts of the region; however, in Ohio and in southern Michigan, levels fell slightly in some wells even though the precipitation was above normal.

Monthend levels were generally above average in the west and north; but in Ohio, except for a well in the center of the state where a record-high level was recorded, ground-water levels were slightly below average.

MIDCONTINENT

[Manitoba and Saskatchewan; Arkansas, Iowa, Kansas, Louisiana, Missouri, Nebraska, North Dakota, Oklahoma, South Dakota, and Texas]

STREAMFLOW INCREASED IN ARKANSAS AND LOUISIANA, AND DECREASED IN KANSAS, NEBRASKA, AND MANITOBA; IN EACH OF THE OTHER STATES, FLOWS OF SOME STREAMS DECREASED AND SOME INCREASED. FLOWS REMAINED ABOVE NORMAL IN PARTS OF NORTH DAKOTA AND IOWA. FLOODING OCCURRED IN LOUISIANA, ARKANSAS, TEXAS, AND OKLAHOMA.

In Iowa, high carryover flows from September, augmented by above-normal October precipitation, resulted in monthly mean flows above the normal range in all parts of the State except the northwest corner, where flows were normal. Monthly mean flow of Winnebago River at Mason City, in the north, was 1400 percent of median and highest in 40 years of record, that of Cedar River at Cedar Rapids, in the east, was 778 percent of median and second highest in the 70-year record, and that of Nishnabotna River above Hamburg, in the southwest, was 400 percent of median and third highest in 45 years of record.

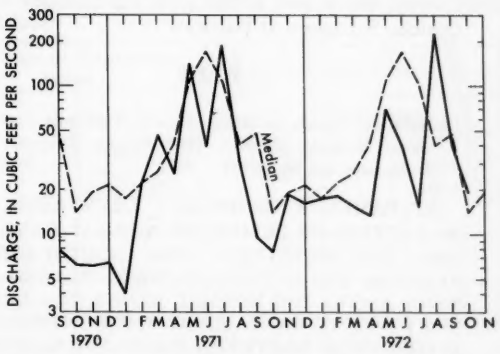
In central Louisiana, flooding occurred October 22 in and near Alexandria as a result of rain totaling as much as 10 inches in the city and from 3 to 5 inches within a 20-mile radius of surrounding area.

In south-central and southwestern Arkansas, and the adjacent area of northeastern Texas, some streams reached moderate flood peak stages October 30 and 31 as a result of relatively large amounts of rain. These areas of the two States were extremely dry prior to this storm.

In southeastern Oklahoma, Glover Creek near Glover (drainage area, 315 square miles) peaked on October 30 at gage height 28.30 feet and discharge of 78,000 cfs. Previous maximum discharge at Glover, since 1908, was 102,000 cfs, at gage height 29.72 feet, on December 25, 1971. Flow at the index station, Washita River near Durwood, in south-central Oklahoma, increased sharply during the last 3 days of October and raised the monthly mean discharge into the normal range for the first time in 5 months.

Seasonal decreases characterized Kansas streamflow, (see graph of Saline River near Russell) where monthly mean discharges remained in the normal range.

The only area of below-normal flow in the region during October was in west-central Texas, where the monthly mean discharge of North Concho River near



Monthly mean discharge of Saline River near Russell, Kans. (Drainage area, 1,502 square miles.)

Carlsbad (drainage area, 1,249 square miles), was 0.006 cfs, 0.2 percent of the median for the month. The September monthly mean at that station was 1,710 percent of the median.

The level of Lake Winnipeg at Gimli, Manitoba, averaged 714.23 feet above mean sea level, 0.71 foot above the long-term mean for October, but 2.14 feet lower than the maximum of record, 716.37 feet, observed in 1927.

Ground-water levels generally rose in Nebraska, eastern Iowa, Arkansas, and Louisiana; and declined in Kansas. Monthend levels were generally above average in Iowa and below average in Kansas, Arkansas, and Louisiana. In the rice-growing area of east-central Arkansas, water levels in the shallow aquifer (Quaternary deposits) remained about the same and were in the same range as October water levels since 1964; water levels in the deep aquifer (Sparta Sand) rose seasonally but reached a new low for the month in the Stuttgart observation well. In the industrial aquifer of central and south Arkansas (Sparta Sand), the level in the key well at Pine Bluff rose 0.73 foot since September but was the lowest of record for October and close to the alltime low. In southwestern Louisiana, water level in the key well in the Chicot aquifer continued to rise (27 feet since June 1972) but was below average for October by nearly 18 feet.

In Texas, water levels rose in the Edwards Limestone at San Antonio and in the Evangeline aquifer at Houston; fell in the Edwards Limestone at Austin; and remained steady in the bolson deposits at El Paso. Monthend levels were above average in the Edwards Limestone at Austin, but levels were below average in the Edwards at San Antonio, in the Evangeline aquifer at Houston, and in the bolson deposits at El Paso (equaling the alltime low). A new October high was recorded in the Carrizo Sand in the Winter Garden area in Dimmit

County, and a new alltime low was recorded in the Ogallala Formation at Plainview.

WEST

[Alberta and British Columbia; Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming]

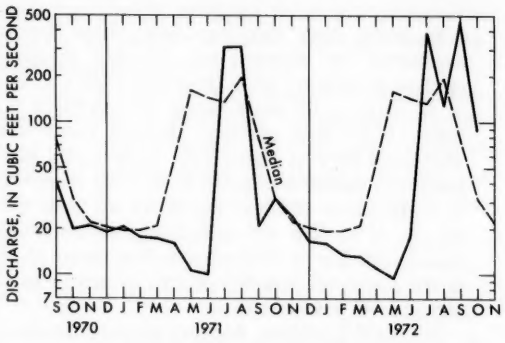
STREAMFLOW GENERALLY DECREASED AND WAS WITHIN OR BELOW THE NORMAL RANGE IN THE NORTHWESTERN AND SOUTHEASTERN PARTS OF THE REGION. FLOWS INCREASED AND WERE ABOVE THE NORMAL RANGE IN A BROAD NORTH-SOUTH BAND ALONG THE CONTINENTAL DIVIDE FROM NORTHERN IDAHO AND MONTANA TO SOUTHERN ARIZONA AND NEW MEXICO. FLOODING OCCURRED IN CALIFORNIA, COLORADO, NEW MEXICO, AND ARIZONA.

In southern British Columbia and Alberta, and parts of Washington, Oregon, Colorado, and New Mexico, streamflow generally decreased for the fourth consecutive month. Elsewhere in the region, flows generally increased seasonally, and were above the normal range in parts of all States along the Continental Divide.

In California, flooding of urban areas in and around San Francisco October 9 to 13, caused extensive property damage and one death. Rainfall in San Francisco was reported to be the highest for October in more than 80 years. Flooding occurred October 18–19 in the San Bernardino area as a result of intense rains in the San Bernardino mountains. In the north-coastal area of California, monthly mean discharge of Smith River near Crescent City increased, but remined in the below-normal range for the 3d consecutive month.

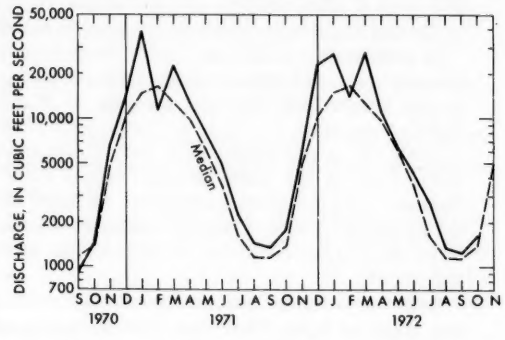
In southwestern Colorado, flooding occurred in and near Durango October 19–20, as a result of rains of about 3 to 7 inches. During the preceding 30 days, more than 9 inches of rain had fallen at Durango, where the October normal precipitation is 1.69 inches. The estimated peak discharge on Lightner Creek near Durango (drainage area, 66 square miles) was 5,000 cfs. Previous maximum discharge there was 1,850 cfs, in record that began in 1927. Florida River at Bondad (drainage area, 221 square miles), peaked at about 3,000 cfs on October 20, more than twice the previous maximum in record beginning in 1956. Only a moderate peak discharge, 5,000 cfs, occurred on Animas River at Durango. Previous maximum discharge at that streamflow station was 25,000 cfs in 1911. Estimated damage during the October flooding was $1 million. No lives were lost.

Damaging floods in central and eastern Arizona during the period October 19–21 were caused by general rains of more than 3 inches. A total of 4.36 inches was reported at Payson, in central Arizona, of which 3.25 inches fell in 24 hours. At least eight persons lost their lives as a result of the storm, and damages were estimated to be about $18 million, mostly to crops and residences. Moderate to severe flooding occurred on October 20 in the San Francisco and Gila River basins of southeastern Arizona and southwestern New Mexico. The maximum amount of rain reported in New Mexico was 4 inches. The peak discharges of several of the streams in the Arizona–New Mexico flood areas were greater than those likely to occur on the average of only once in 50 years (see accompanying table of peak stages and discharges). Monthly mean discharge was above the normal range at all index stations in Arizona and at two stations in New Mexico. Also, new maximum monthly mean discharges for October occurred at four Arizona stations and one in New Mexico. New maximum daily means for the month occurred at three stations in Arizona and one in New Mexico. In east-central New Mexico, flow of Pecos River at Santa Rosa decreased seasonally, and was well above the October median, but in the normal range (see graph).



Monthly mean discharge of Pecos River at Santa Rosa, N. Mex. (Drainage area, 2,650 square miles.)

In southwestern Oregon, flow of Umpqua River near Elkton increased seasonally and was in the normal range (see graph). In contrast, monthly mean discharge of



Monthly mean discharge of Umpqua River near Elkton, Oreg. (Drainage area, 3,683 square miles.)

Provisional data; subject to revision

STAGES AND DISCHARGES FOR THE FLOODS OF OCTOBER AT SELECTED SITES IN ARIZONA AND NEW MEXICO

WRD station number	Stream and place of determination	Drainage area (square miles)	Period of known floods	Maximum flood previously known			Maximum during present flood				
				Date	Stage (feet)	Discharge (cfs)	Date	Stage (feet)	Discharge		Recurrence interval (years)
									Cfs	Cfs per square mile	
ARIZONA											
LITTLE COLORADO RIVER BASIN											
9–4014	Moenkopi Wash near Tuba City.	2,500	1926–	Aug. 4, 1929	[a]15.4	15,100	Oct. 19	21	17,000	6.8	22
GILA RIVER BASIN											
9–4420	Gila River near Clifton	4,010	1891–	Sept. 29, 1941	[a]20.12	28,200	21	18.7	36,000	9.0	[b]1.3
9–4445	San Francisco River near Clifton.	2,766	1891–	Dec. 3, 1906	------	143,000	20	15.5	70,000	25.4	30
9–4485	Gila River at head of Safford Valley near Solomon.	7,896	1914–	Jan. 19, 1916	15.9	100,000	20	15.6	70,000	8.9	30
9–4665	Gila River at Calva	11,470	1914–	Jan. 20, 1916	------	100,000	20	[c]15.6	80,000	7.0	50
9–4905	Black River near Fort Apache.	1,232	1912–	Dec. 30, 1965	20.05	24,800	21	21.5	30,000	24.3	22
NEW MEXICO											
GILA RIVER BASIN											
9–4320	Gila River below Blue Creek near Virden.	3,203	1927–	Sept. 29, 1941	25.78	41,700	20	21.9	27,200	8.5	30
9–4430	San Francisco River near Alma.	1,546	1905, 1964–	Nov. 26, 1905	14	25,000	20	15.18	[d]20,000	12.9	------
9–4440	San Francisco River near Glenwood.	1,653	1927–	Dec. 30, 1965	11.00	8,200	20	------	[d]30,000	18.1	------

[a]Site and datum then in use.
[b]Ratio of peak discharge to that of 50-year flood.
[c]Gage height at station near Bylas (9–4663).
[d]About.

Wilson River near Tilamook, in the north-coastal area of the State, decreased to less than half the monthly mean flow during September, and was below the normal range.

In southern and southeastern Idaho, monthly mean discharges of Snake River at Weiser and Heise, were highest for October in 60 and 63 years of record, respectively. The flow at Weiser was augmented by large releases from reservoirs upstream.

In Montana, streamflow was above the normal range in basins east of the Continental Divide and near normal on the western slopes. Last winter's exceptionally heavy snow pack in the high mountains in the southern part of the State is still contributing to the above-normal flows.

Flow of Beaver River near Beaver, in southwestern Utah, increased, and was in the normal range for the first time in 6 months. In northern Utah, level of Great Salt Lake increased 0.30 foot during the month (to 4,198.30 feet above mean sea level) and was 1.05 feet higher than a year ago.

Reservoir storage in the region generally remained near or above average in most major reservoirs. One exception was Pend Oreille Lake, in northern Idaho, which continued at a low level because of heavy demands for power production. Net increase in storage in the Colorado Storage Project was 608,600 acre-feet.

Ground-water levels declined in Washington, western Montana, western Idaho, and California; however, levels rose in New Mexico, central and eastern Idaho, and in Utah as a result of decreased pumpage. The rises were greater in central Utah than in the northern and southeastern parts of the State. Monthend levels were generally above average in the region, but in the Rupert-Minidoka area of Idaho and Truckee Meadows and Las Vegas Valley in Nevada, levels were below average because of pumping. Despite general seasonal rises of water levels in New Mexico, levels reamined below average and in the shallow ground-water aquifer in the southern part of the Roswell basin, a record all-time low was reached. In Montana and eastern Washington, levels were above average but lower than in October 1971.

Provisional data; subject to revision

USABLE CONTENTS OF SELECTED RESERVOIRS NEAR END OF OCTOBER 1972

[Contents are expressed in percent of reservoir capacity. The usable storage capacity of each reservoir is shown in the column headed "Normal maximum."]

Reservoir Principal uses: F—Flood control I—Irrigation M—Municipal P—Power R—Recreation W—Industrial	End of Sept. 1972	End of Oct. 1972	End of Oct. 1971	Average for end of Oct.	Normal maximum
	Percent of normal maximum				
NORTHEAST REGION					
NOVA SCOTIA					
Rossignol, Mulgrave, Falls Lake, St. Margaret's Bay, Black, and Ponhook Reservoirs (P)	38	36	39	32	223,400 (a)
QUEBEC					
Gouin (P)	57	63	60	70	6,487,000 ac-ft
Allard (P)	81	86	83	53	280,600 ac-ft
MAINE					
Seven reservoir systems (MP)	68	58	43	49	179,300 mcf
NEW HAMPSHIRE					
Lake Winnipesaukee (PR)	77	63	65	51	7,200 mcf
Lake Francis (FPR)	69	76	75	75	4,326 mcf
First Connecticut Lake (P)	76	79	79	76	3,330 mcf
VERMONT					
Somerset (P)	57	61	71	68	2,500 mcf
Harriman (P)	61	60	62	60	5,060 mcf
MASSACHUSETTS					
Cobble Mountain and Borden Brook (MP)	67	66	75	71	3,394 mcf
NEW YORK					
Great Sacandaga Lake (FPR)	64	52	67	55	34,270 mcf
Indian Lake (FMP)	87	81	55	51	4,500 mcf
New York City reservoir system (MW)	77	68	67	-----	547,500 mg
NEW JERSEY					
Wanaque (M)	98	57	89	63	27,730 mg
PENNSYLVANIA					
Wallenpaupack (P)	61	59	44	45	6,875 mcf
Pymatuning (FMR)	96	91	80	75	8,191 mcf
MARYLAND					
Baltimore municipal system (M)	99	98	100	81	85,340 mg
SOUTHEAST REGION					
NORTH CAROLINA					
Bridgewater (Lake James) (P)	79	78	91	81	12,580 mcf
High Rock Lake (P)	62	50	100	57	10,230 mcf
Narrows (Badin Lake) (P)	93	93	100	96	5,616 mcf
SOUTH CAROLINA					
Lake Murray (P)	83	80	85	58	70,300 mcf
Lakes Marion and Moultrie (P)	86	86	62	61	81,100 mcf
SOUTH CAROLINA—GEORGIA					
Clark Hill (FP)	68	55	65	50	75,360 mcf
GEORGIA					
Burton (PR)	67	69	85	63	104,000 ac-ft
Lake Sidney Lanier (FMPR)	48	40	55	48	1,686,000 ac-ft
Sinclair (MPR)	64	61	76	70	214,000 ac-ft
ALABAMA					
Lake Martin (P)	70	59	80	63	1,373,000 ac-ft
TENNESSEE VALLEY					
Clinch Projects: Norris and Melton Hill Lakes (FPR)	46	47	51	30	1,166,000 cfsd
Holston Projects: South Holston, Watauga, Boone, Fort Patrick Henry, and Cherokee Lakes (FPR)	63	63	61	35	1,452,000 cfsd
Douglas Lake (FPR)	38	37	43	21	715,800 cfsd
Hiwassee Projects: Chatuge, Nottely, Hiwassee, Apalachia, Blue Ridge, Ocoee 3, and Parksville Lakes (FPR)	62	54	61	46	523,700 cfsd
Little Tennessee Projects: Nantahala, Thorpe, Fontana, and Chilhowee Lakes (FPR)	65	64	59	45	751,400 cfsd
WESTERN GREAT LAKES REGION					
WISCONSIN					
Chippewa and Flambeau (PR)	92	96	95	74	15,900 mcf
Wisconsin River (21 reservoirs) (PR)	89	93	75	62	17,400 mcf
MINNESOTA					
Mississippi River headwater system (FMR)	36	32	36	29	1,640,000 ac-ft

Reservoir Principal uses: F—Flood control I—Irrigation M—Municipal P—Power R—Recreation W—Industrial	End of Sept. 1972	End of Oct. 1972	End of Oct. 1971	Average for end of Oct.	Normal maximum
	Percent of normal maximum				
MIDCONTINENT REGION					
NORTH DAKOTA					
Lake Sakakawea (Garrison) (FIPR)	96	96	95	-----	22,640,000 ac-ft
NEBRASKA					
Lake McConaughy (IP)	75	75	90	65	1,948,000 ac-ft
OKLAHOMA					
Keystone (FPR)	80	79	89	87	661,000 ac-ft
Lake O' The Cherokees (FPR)	86	92	88	80	1,492,000 ac-ft
Tenkiller Ferry (FPR)	80	80	85	87	628,200 ac-ft
Lake Altus (FIMR)	9	9	11	48	134,500 ac-ft
Eufaula (FPR)	67	70	101	82	2,378,000 ac-ft
OKLAHOMA—TEXAS					
Lake Texoma (FMPRW)	78	75	91	92	2,722,000 ac-ft
TEXAS					
Possum Kingdom (IMPRW)	95	95	98	81	724,500 ac-ft
Buchanan (IMPW)	82	78	100	77	955,200 ac-ft
Bridgeport (IMW)	53	51	57	60	270,900 ac-ft
Eagle Mountain (IMW)	90	90	96	86	182,700 ac-ft
Medina Lake (I)	99	98	100	47	254,000 ac-ft
Lake Travis (FIMPRW)	83	87	100	78	1,144,000 ac-ft
Lake Kemp (IMW)	45	45	26	52	461,800 ac-ft
THE WEST					
ALBERTA					
Spray (P)	84	81	77	74	210,000 ac-ft
Lake Minnewanka (P)	91	89	78	80	199,700 ac-ft
St. Mary (I)	60	66	71	61	320,800 ac-ft
WASHINGTON					
Franklin D. Roosevelt Lake (IP)	90	98	96	97	5,232,000 ac-ft
Lake Chelan (PR)	91	78	70	73	676,100 ac-ft
IDAHO—WYOMING					
Upper Snake River (7 reservoirs) (IMP)	72	73	77	49	4,282,000 ac-ft
WYOMING					
Pathfinder, Seminoe, Alcova, Kortes, and Glendo Reservoirs (I)	59	60	67	31	3,016,000 ac-ft
Buffalo Bill (IP)	90	82	90	75	421,300 ac-ft
Boysen (FIP)	88	85	94	81	802,000 ac-ft
Keyhole (F)	88	85	78	32	199,900 ac-ft
COLORADO					
John Martin (FIR)	0	0	0	14	364,400 ac-ft
Colorado—Big Thompson project (I)	76	71	75	52	722,600 ac-ft
Taylor Park (IR)	49	33	71	52	106,000 ac-ft
COLORADO RIVER STORAGE PROJECT					
Lake Powell; Flaming Gorge, Navajo, and Blue Mesa Reservoirs (IFPR)	56	57	58	-----	31,276,500 ac-ft
UTAH—IDAHO					
Bear Lake (IPR)	86	85	84	55	1,421,000 ac-ft
CALIFORNIA					
Hetch Hetchy (MP)	57	49	56	47	360,400 ac-ft
Lake Almanor (P)	73	76	76	44	1,036,000 ac-ft
Shasta Lake (FIPR)	75	75	74	63	4,377,000 ac-ft
Millerton Lake (FI)	29	36	31	30	503,200 ac-ft
Pine Flat (FI)	21	24	38	35	1,014,000 ac-ft
Isabella (FIR)	9	9	22	20	551,800 ac-ft
Folsom (FIP)	66	61	62	51	1,000,000 ac-ft
Lake Berryessa (FIMW)	72	71	85	73	1,600,000 ac-ft
Clair Engle Lake (Lewiston) (P)	78	76	81	71	2,438,000 ac-ft
CALIFORNIA—NEVADA					
Lake Tahoe (IPR)	65	61	71	49	744,600 ac-ft
NEVADA					
Rye Patch (I)	85	80	86	40	179,100 ac-ft
ARIZONA—NEVADA					
Lake Mead and Lake Mohave (FIMP)	67	69	66	67	27,970,000 ac-ft
ARIZONA					
San Carlos (IP)	5	31	10	12	948,600 ac-ft
Salt and Verde River system (IMPR)	27	55	41	32	2,073,000 ac-ft
NEW MEXICO					
Conchas (FIR)	60	60	43	77	352,600 ac-ft
Elephant Butte and Caballo (FIPR)	7	10	3	24	2,539,000 ac-ft

[a] Thousands of kilowatt-hours.

Provisional data; subject to revision

USABLE CONTENTS OF SELECTED RESERVOIRS, SEPTEMBER 30, 1972, SUPPLEMENTING LIST OF RESERVOIRS IN SEPTEMBER ISSUE OF THE WATER RESOURCES REVIEW

[Contents are expressed in percent of reservoir capacity. The usable storage capacity of each reservoir is shown in the column headed "Normal maximum."]

Reservoir Principal uses: F–Flood control I–Irrigation M–Municipal P–Power R–Recreation W–Industrial	End of Aug. 1972	End of Sept. 1972	End of Sept. 1971	Average for end of Sept.	Normal maximum ac-ft
	Percent of normal maximum				
SOUTHEAST REGION					
KENTUCKY					
Herrington Lake (P)	-------	43	41	43	123,000
Lake Cumberland (FP)	-------	71	84	59	3,988,000
WESTERN GREAT LAKES REGION					
OHIO					
Milton and Berlin (FRW)	-------	47	34	34	120,300
Hoover (MR)	-------	69	48	52	85,890
MIDCONTINENT REGION					
ARKANSAS					
Norfork (FPR)	78	74	77	85	1,249,000
MISSOURI					
Lake of the Ozarks (PR)	81	78	82	86	1,218,000
SOUTH DAKOTA					
Big Bend (FPR)	102	101	100	97	1,725,000
Fort Randall (FIPR)	82	77	78	62	5,108,000
Oahe (FIPR)	90	84	85	-------	22,530,000
Lewis and Clark Lake (FIPR)	92	99	99	98	477,000
Angostura (FIPR)	78	73	71	75	127,600
Belle Fourche (IR)	64	55	30	32	185,200
Pactola (FIMR)	94	94	90	72	55,700
Shadehill (FI)	95	86	80	81	81,400
TEXAS					
Livingston (MWIR)	96	95	80	-------	1,750,000
Toledo Bend (MWIRP)	87	80	88	72	4,473,000
International Falcon (IPRF)	94	97	100	-------	2,764,000
Twin Buttes (MIF)	40	41	47	0	177,800
Red Bluff (IRP)	11	14	13	25	307,000
THE WEST					
BRITISH COLUMBIA					
Kootenay Lake (P)	78	85	93	100	787,000
WASHINGTON					
Lake Cushman (P)	97	92	83	88	371,900
Ross (FMP)	100	99	98	-------	1,052,000
Lake Merwin (P)	-------	101	96	85	263,400
OREGON					
McKay (I)	29	12	23	16	73,830
Lake Owyhee (I)	69	63	66	45	715,000
Upper Klamath Lake (IP)	75	68	77	45	584,000
IDAHO					
Arrowrock, Anderson Ranch, and Lucky Peak Reservoirs and Lake Lowell (FIPR)	65	56	63	47	1,235,000
Pend Oreille Lake (FPR)	98	87	96	93	1,561,000
Coeur d' Alene Lake (P)	132	110	106	82	177,900
MONTANA					
Fort Peck (FIPR)	92	91	89	62	19,140,000
Canyon Ferry (FIMPR)	84	79	88	86	2,043,000
Fresno (IR)	54	59	29	53	127,200
Tiber (FIR)	50	45	41	49	1,313,000
Bighorn Lake (I)	77	79	79	70	1,356,000
Six major hydroelectric reservoirs (P)	99	94	86	84	583,000
Flathead Lake (FIPR)	100	99	95	98	1,791,000
Hungry Horse (FIP)	100	97	95	97	3,428,000
Noxon Rapids (PR)	94	97	96	98	334,600
CALIFORNIA					
El Capitan (IM)	10	9	17	-------	112,800
San Vicente (M)	66	68	67	-------	90,230
ARIZONA					
Bartlett (FIMR)	26	17	40	-------	178,500
Horseshoe (FIMPR)	1	2	8	-------	139,200

Provisional data; subject to revision

FLOW OF LARGE RIVERS DURING OCTOBER 1972

WRD station number	Stream and place of determination	Drainage area (square miles)	Mean annual discharge through September 1970	October 1972					
				Monthly discharge (cfs)	Percent of median monthly, discharge[1]	Change in discharge from previous month (percent)	Discharge near end of month		
							(cfs)	(mgd)	Date
1–0140	St. John River below Fish River at Fort Kent, Maine.	5,690	9,397	10,090	214	+28	19,300	12,500	31
1–3580	Hudson River at Green Island, N.Y.	8,090	12,520	5,320	94	-16	6,540	4,230	31
1–4635	Delaware River at Trenton, N.J	6,780	11,360	3,946	94	-2	5,090	3,290	29
1–5705	Susquehanna River at Harrisburg, Pa.	24,100	33,670	6,589	72	+2	5,650	3,650	31
1–6465	Potomac River near Washington, D.C.	11,560	[2]10,640	11,100	390	+240	4,300	2,780	31
2–1055	Cape Fear River at William O. Huske Lock near Tarheel, N.C.	4,810	4,847	2,740	130	+81	1,700	1,020	28
2–1310	Pee Dee River at Peedee, S.C	8,830	9,098	4,699	101	+19	5,430	3,510	29
2–2260	Altamaha River at Doctortown, Ga.	13,600	13,380	2,521	52	-24	2,210	1,430	22
2–3205	Suwannee River at Branford, Fla	7,740	6,775	2,900	63	-31	2,850	1,840	28
2–3580	Apalachicola River at Chattahoochee, Fla.	17,200	21,690	9,760	89	-10	9,840	6,360	30
2–4670	Tombigbee River at Demopolis lock and dam near Coatopa, Ala.	15,400	21,700	2,570	112	-11	2,100	1,360	25
2–4895	Pearl River near Bogalusa, La	6,630	8,533	2,086	105	+12	2,680	1,730	30
3–0495	Allegheny River at Natrona, Pa	11,410	[2]18,700	9,865	226	+72	11,500	7,430	27
3–0850	Monongahela River at Braddock, Pa.	7,337	[2]11,950	6,714	468	+116	3,040	1,960	27
3–1930	Kanawha River at Kanawha Falls, W.Va.	8,367	12,370	10,230	225	+151	8,610	5,560	29
3–2345	Scioto River at Higby, Ohio	5,131	4,337	3,601	618	+98	1,790	1,160	30
3–2945	Ohio River at Louisville, Ky[3]	91,170	110,600	51,100	266	+117	33,800	21,800	29
3–3775	Wabash River at Mount Carmel, Ill.	28,600	26,310	22,500	441	+18	15,400	9,950	31
3–4690	French Broad River below Douglas Dam, Tenn.	4,543	[2]6,528	6,971	198	+22	----------	----------	------
4–0845	Fox River at Rapide Croche Dam, near Wrightstown, Wis.[3]	6,150	4,142	7,300	342	+2	----------	----------	------
4–2643.31	St. Lawrence River at Cornwall, Ontario–near Massena, N.Y.[4]	299,000	239,100	303,800	137	-2	296,000	191,000	27
5–0825	Red River of the North at Grand Forks N. Dak.	30,100	2,439	1,749	128	-5	1,900	1,230	31
5–3300	Minnesota River near Jordan, Minn ..	16,200	3,306	1,740	182	-14	2,090	1,350	30
5–3310	Mississippi River at St. Paul, Minn ...	36,800	[2]10,230	10,880	169	-18	11,000	7,110	29
5–3655	Chippewa River at Chippewa Falls, Wis.	5,600	5,062	8,504	328	----------	7,000	4,500	31
5–4070	Wisconsin River at Muscoda, Wis	10,300	8,457	19,248	351	----------	14,500	9,370	31
5–4465	Rock River near Joslin, Ill	9,520	5,288	----------	----------	----------	----------	----------	------
5–4745	Mississippi River at Keokuk, Iowa ...	119,000	61,210	107,200	338	+26	103,000	66,600	30
5–4905	Des Moines River at Keosauqua, Iowa.	14,038	5,220	5,868	383	-27	10,600	6,850	31
6–2145	Yellowstone River at Billings, Mont.	11,795	6,754	6,440	163	-3	----------	----------	------
6–9345	Missouri River at Hermann, Mo	528,200	78,480	69,490	162	-18	81,600	52,700	26
7–2890	Mississippi River near Vicksburg, Miss.[5]	1,144,500	552,700	413,000	192	+23	431,000	279,000	31
9–3150	Green River at Green River, Utah ...	40,600	6,369	4,831	195	+132	5,600	3,620	31
9–4025	Colorado River near Grand Canyon, Ariz.	137,800	.....	13,790	----------	-12	----------	----------	------
11–4255	Sacramento River at Verona, Calif ...	21,257	18,370	----------	----------	----------	----------	----------	------
14–1057	Columbia River at The Dalles, Oreg.[6]	237,000	194,000	117,500	137	-9	----------	----------	------
14–1910	Willamette River at Salem, Oreg	7,280	23,370	10,500	98	-12	----------	----------	------
15–5155	Tanana River at Nenana, Alaska	27,500	24,040	----------	----------	----------	----------	----------	------
	Fraser River at Hope, British Columbia.	78,300	95,300	69,000	119	-14	72,700	47,000	30

[1] Reference period 1931–60 or 1941–70.
[2] Adjusted.
[3] Record furnished by Corps of Engineers.
[4] Record furnished by Buffalo district, Corps of Engineers, through International St. Lawrence River Board of Control. Discharges shown are considered to be the same as discharge at Ogdensburg, N.Y. when adjusted for storage in Lake St. Lawrence.
[5] Records of daily discharge computed jointly by Corps of Engineers and Geological Survey.
[6] Discharge determined from information furnished by Bureau of Reclamation, Corps of Engineers, and Geological Survey.

ALASKA

Streamflow decreased at all index stations in the State but was above the normal range on Chena River at Fairbanks and Little Susitna River near Palmer, in the central and south-central sections respectively, because of unseasonably warm temperatures and above-normal rainfall. The monthly mean discharge of Little Susitna River near Palmer (drainage area, 61.9 square miles), was 211 cfs, highest for the month in 24 years of record. In southeastern Alaska, the low monthly flow of Sheep Creek near Juneau, only 69 percent of the October median, contrasted with flood flows just offshore on Baranof and Chichagof Islands. During the flooding, the peak discharge of Baranof River at Baranof on October 5 was about 10,000 cfs, roughly 2½ times the previous maximum discharge in 26 years of record. Also on Baranof Island, a peak discharge of about 9,300 cfs occurred on Sawmill Creek at the outlet of Blue Lake, near Sitka, at a site about 1½ miles upstream from that of a discontinued gaging station at which the largest peak discharge in 28 years of record was 7,100 cfs.

Ground-water levels rose slightly in the Kenai and Anchorage areas.

LISTS OF SELECTED WATER REPORTS OF THE GEOLOGICAL SURVEY

The *Water Resources Review* describes and lists from time to time some of the water publications of the United States and Canada. A group of the lists of U.S. water reports by the Geological Survey that have been described within the past year in the *Review* has been compiled. Single copies of the 8-page compilation ("Water Resources Review—Reference lists of selected reports") may be obtained free upon request to the U.S. Geological Survey, Water Resources Review (code 4200–5214), Washington, D.C. 20242. The reports listed in the compilation include three principal types: (1) basic-data reports (water-supply paper series) containing information on stream discharge, quality of water in streams, and water levels in wells; (2) manual reports, in the series "Techniques of water-resources investigations", describing methods and procedures for carrying out studies of water resources; and (3) flood-plain maps published in the hydrologic atlas series.

WATER RESOURCES REVIEW **OCTOBER 1972**

Cover map shows generalized pattern of streamflow for October based on 22 index stream-gaging stations in Canada and 130 index stations in the United States. Alaska and Hawaii inset maps show streamflow only at the index gaging stations which are located near the points shown by the arrows.

Streamflow for October 1972 is compared with flow for October in the 30-year reference period 1931–60 or 1941–70. Streamflow is considered to be *below normal* if it is within the range of the low flows that have occurred 25 percent of the time (below the lower quartile) during the reference period. Flow for October is considered to be *above normal* if it is within the range of the high flows that have occurred 25 percent of the time (above the upper quartile).

Flow higher than the lower quartile but lower than the upper quartile is described as being within the *normal range.* In the Water Resources Review *normal flow* is defined as the median of the 30 flows of October during the reference period. The normal (median) has been obtained by ranking those 30 flows in their order of magnitude; the highest flow is number 1, the lowest flow is number 30, and the average of the 15th and 16th highest flows is the normal (median).

The normal is an average (but not an arithmetic average) or middle value; half of the time you would expect the October flows to be below the median and half of the time to be above the median. Shorter reference periods are used for the Alaska index stations because of the limited records available.

Statements about *ground-water levels* refer to conditions near the end of October. Water level in each key observation well is compared with average level for the end of October determined from the entire past record for that well or from a 20-year reference period, 1951–70. *Changes in ground-water levels* unless described otherwise, are from the end of September to the end of October.

The Water Resources Review is published monthly. Special-purpose and summary issues are also published. In the United States, issues of the Review are free on application to the Water Resources Review, U.S. Geological Survey, Washington, D.C. 20242.

This issue was prepared by J.C. Kammerer, H.D. Brice, E.W. Coffay, C. R. Murray, and L.C. Fleshmon from reports of the field offices, November 7, 1972.

GROUND WATER FOR IRRIGATION FROM GLACIAL OUTWASH IN THE PERHAM AREA, MINNESOTA

The accompanying abstract (abridged) and map are from the report, *Availability of ground water for irrigation from glacial outwash in the Perham area, Otter Tail County, Minnesota,* by Harold O. Reeder, U.S. Geological Survey Water-Supply Paper 2003, 45 pages, 1972; prepared in cooperation with the West-Central Minnesota Resource Conservation and Development Committee and the Minnesota Department of Conservation, Division of Waters, Soils, and Minerals. Water-Supply Paper 2003 may be purchased for $1.00 from the Superintendent of Documents, Government Printing Office, Washington, D.C. 20402.

ABSTRACT

The Perham study area includes about 350 square miles of surficial deposits of glacial outwash in the central part of Otter Tail County in west-central Minnesota (fig. 1). The aquifer characteristics have a wide range, as follows: Transmissivity values range from nearly 0 along the perimeter of the area to more than 100,000 gallons per day per foot in the central parts of the area; storage coefficient values range from 0.1 to 0.2; and the saturated thickness of the upper outwash material ranges from nearly 0 to more than 100 feet. Most of the aquifer material is fairly well sorted and is in the particle-size range of fine to coarse sand.

Wells penetrating the full thickness of the aquifer and developed to 100-percent efficiency can be expected to yield 1,200 gallons per minute for 30 days and to have drawdowns of less than two-thirds the aquifer thickness in much of the area. Yields of 300 gallons per minute or less can be expected from wells drilled near the edges of the area.

Results from the mathematical analyses show that the amount of streamflow leaving the area will not be depleted within the 10-year analysis period, if not more than 6 inches of water per year is used on all the irrigable land in the outwash area. However, owing to the heterogeneity of the aquifer and the other variable factors involved, some reaches of the streams may cease to flow when full ground-water development is approached, which, in turn, would result in a decline in some lake levels.

If irrigation wells and other large-yield wells in the study area are spaced 1 mile or more away from streams and lakes, the effect of ground-water pumping on the streams will be small, and the lake levels will be affected very little. However, the lakes and ponds are expected to approach normal levels during periods of above-normal precipitation and during periods of no pumping.

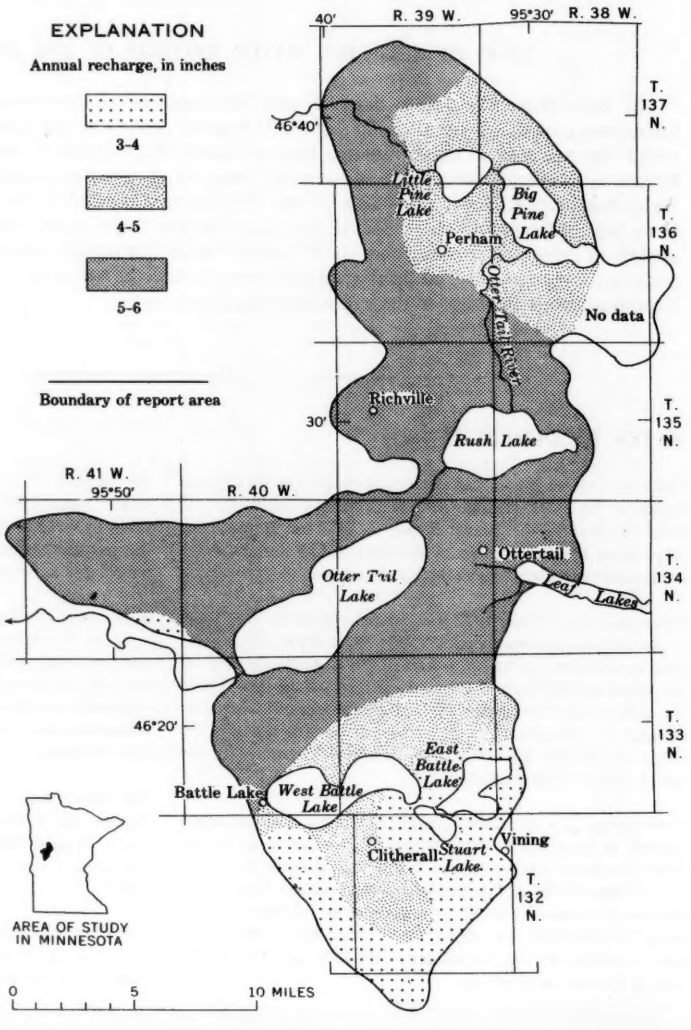


Figure 1.—Annual recharge, in inches, to the ground-water reservoir from precipitation.

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